Rail Anchor Slip Force Testing

Exhibit D

Research Project Requirement Template

Recipient/Grant (Contract) Number: University of Texas Rio Grande Valley (UTRGV)/Grant No. 69A3552348340

Center Name: University Transportation Center for Railway Safety (UTCRS)

Research Priority: Promoting Safety

Principal Investigator(s): Dr. Mustapha Rahmaninezhad (PI), Dr. Mohsen Amjadian (co-PI), Dr. Siang Zhou (co-PI), Dr. Arturo Fuentes (co-PI), Dr. Constantine Tarawneh (co-PI)

Project Partners: MxV Rail, BNSF

Research Project Funding: $114,814 (Federal), $71,316 (Non-Federal Cost Share)

Project Start and End Date: 09/01/2023 to 08/31/2024

Project Description: In recent decades, studies have focused on continuous welded rail (CWR) for its growing adoption as a replacement for jointed track. Key reasons include improved ride quality, increased rail and rolling stock fatigue life, and reduced track maintenance costs. However, the absence of joints introduces challenges such as thermal expansion-related track buckling in summer and tensile pull-apart failures in winter, often causing catastrophic derailments. Two significant safety-affecting failure modes are lateral stability loss (track buckling, shift, and radial breathing) and rail pull apart (rail break under high tensile forces). Buckled tracks in lateral and vertical planes can lead to vehicle derailments due to incompatibility with normal operating speeds. The lateral and longitudinal resistances play critical roles in ensuring the stability of a track and minimize the damage of the temperature stress in the rails. Several methods have been proposed to enhance both the lateral and longitudinal track resistances. These methods include (1) employing winged and framed ties, (2) modification on the shape of the tie bottom surface, (3) employing wider ties, and (4) using anchors. Installing rail anchors (clamps) between rails and ties can improve track stability by distributing the loads from rail into the ties, thereby improving longitudinal resistance. In this study, a series of full-scale railway track model tests will be conducted to examine the effect of rail anchors on the longitudinal resistance of tracks. Towards that goal, a series of full-scale model laboratory testing will be conducted to evaluate the longitudinal resistances of anchored rails with different anchor types, patterns, tightness, and conditions, and to investigate the life cycle of these rail anchors. A full-scale laboratory test setup will be designed and fabricated for this study. The acquired results will be used to identify conditions that can lead to a reduction in anchor slip resistance. This study will represent a preliminary step towards a comprehensive study on ballast bed anchored tracks.

US DOT Priorities: The proposed work in this project is aligned with three of the six USDOT strategic goals: **(a) Safety:** The project directly investigates a potential safety concern that has been identified by Class I railroads and MxV Rail engineers. **(b) Economic Strength:** Unscheduled stoppages and field repairs cause serious economic losses for rail companies and their customers, and other users of the track. **(c) Equity:** UTRGV is a minority serving institution with an established record of training students from underrepresented groups and placing them in professional positions in the transportation industry. This project will directly employ three undergraduate and one graduate student who will perform the experimental testing and data analysis. These students will also undergo professional training at MxV Rail facilities as part of them receiving relevant workforce development opportunities. **(d) Sustainability:** By characterizing the rail anchor slip forces, design enhancements

and field implementation of these anchors can be optimized which will extend the useful lifetime of rail track ties and mitigate the number of environmentally-significant derailments caused by rail buckling and rail pull apart failures.

Outputs: The expected products include:

a. Design and fabrication of a self-reacting loading system on a testing platform.
b. Rail anchor slip forces for several different rail anchor configurations and anchor types.
c. Final report documenting all the acquired results.
d. One or more conference or journal publications prepared by the students and PIs. At a minimum, an abstract and a manuscript of a paper will be submitted to the Geo-Congress 2025 and TRB 2025, respectively.

Outcomes/Impacts: The primary impact of the research is characterizing and quantifying the rail anchor slip forces for several simulated rail service conditions and whether removal and re-application of these rail anchors affects the slip resistance. However, the research will have impacts beyond this specific question. **Industry Impact:** The results could lead to recommendations for industry best practices; for example, a recommendation for proper use of rail anchors and optimized configurations as well as design optimizations or enhancements to increase slip resistance. **Educational Impact:** The project will be carried out by undergraduate and graduate students working under the supervision of the PIs. As a minority serving institution in a rapidly growing metropolitan area, we anticipate that most of the students will be from underrepresented groups, and that these students will have the chance to work with MxV Rail engineers and spend some time during the summer at MxV Rail facilities. The students will gain invaluable experience in designing and fabricating the laboratory test setup and in conducting tests according to AAR standards. We anticipate that at least three undergraduates and one graduate student will participate in the various aspects of the project.

Final Research Report: Upon completion of the project, a URL link to the final report will be provided.